B-6145
1/04

Producing Pine Straw in East Texas Forests

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A Growing Enterprise

Managing pine forests for the production of pine straw is a promising new enterprise in East Texas that may supplement the income of Texas forest landowners. Pine straw is increasingly popular in Texas as a ground cover mulch because it is clean, attractive and an exceptional value for most landscaping situations.

Although pine straw popularity is fairly recent in Texas, it has been a popular landscape ground cover throughout the South for the past 25 years. In fact, it is one of the most widely used mulches for all size projects from residential flower beds to industrial complexes and highway landscapes. Landscapers, building contractors and homeowners have discovered that pine straw has superior properties to other mulches. Unlike other dry organic mulches such as pine bark, leaves, grass clippings and peat moss, pine straw helps provide favorable growing conditions and stimulates healthy plant development (Fig. 1) because it:

- Insulates tender roots from temperature extremes, keeping the soil warm during cold spells and cool during warm periods.
- Conserves soil moisture by reducing water evaporation and moisture loss.
- Encourages water penetration into the soil and reduces runoff.
- Eliminates erosion by wind and rain.
- Protects against soil compaction by reducing the impact of rain directly on the soil surface.
- Promotes favorable soil tilth for healthy root growth.

Pine straw may also hinder the establishment of weeds and soil-borne diseases. Pine needles interlock and hold together during hard rains and heavy winds, even on sloping landscapes. Because pine needles interlock, pine straw will not wash out of beds like some other mulches.

Pine straw remains loose and friable and does not form a top crust like grass clippings, leaves and some wood mulches. Loose mulch allows water to penetrate the soil and prevents wasteful irrigation runoff. The large air pockets help prevent the soil from remaining excessively wet and damaging plant roots. Lastly, the fine texture and uniform color of pine straw is more aesthetically pleasing to some people. Its attractive, earthy look brings out the color, contrast and texture of landscapes.

Figure 1. Pine straw is a high quality mulch for landscapes and gardens.

Definitions

Basal Area — a measure of the density or stocking of a forest stand. It is the cross-sectional area of a tree bole (trunk), including the bark, measured at 4.5 feet above the ground. The sum of individual tree basal areas on an acre of land equals the total basal area per acre expressed in square feet per acre.

Cleaning — preparing the stand to rake pine straw by removing ground debris, such as limbs, cones, hardwood leaves and trash, and low hanging limbs that will interfere with mechanical raking and baling.

Pine Straw — the fresh, undecomposed pine needles that have fallen to the forest floor.

Rotation — the length of time between the initial establishment of a pine plantation and the final harvest.

Understory — all the plants growing under the main canopy of the pine trees.

Types of Pine Straw Bales

Four species of southern yellow pines grow in Texas. In order of needle length from longest to shortest, the species are longleaf, slash, loblolly and shortleaf. Slash and longleaf pine are primarily distributed in Southeast Texas. Shortleaf is found chiefly in Northeast Texas. Loblolly grows evenly throughout East Texas. All of the species make first-rate mulch. Shortleaf is too short to bale but may be marketed in bags or shrink-wrapped bales.

Pine straw is sold in round bales, square bales and bags weighing 25 to 50 pounds and yielding 3 to 6 cubic feet (Fig. 2). Square bales typically measure 14 by 14 by 26 inches; 40-pound round bales are 18 inches in diameter and 26 inches in long. Customers tend to prefer smaller, lighter bales. Collection points (Fig. 3) buy loose straw from small growers and homeowners.

About 3 inches of pine straw, which settles to 1.5 inches, should be used in new applications. That equals 1/2 pound of straw per square foot. An additional inch per year is required to maintain the proper depth. Pine straw is usually less expensive than other organic mulches, from $1.60 to $4.60 less per 10- by 10-foot bed.

Figure 2. A 40-pound bale will cover about 100 square feet.

Figure 3. Pine straw bulk buying collection points, like this one in Garrison, Texas, buy loose straw from the public.

Value to the Landowner

Pine straw is a renewable resource that can be harvested each year in Texas, and you don't have to cut down the trees to collect it. Landowners who sell pine straw can earn income from their pine plantations for several years before the trees are big enough to harvest for pulpwood and saw timber.

With wise management, pine straw can substantially increase the return on the landowner's forest land investment. Pine straw currently sells at wholesale for $5 to $10 per 25- to 50-pound bale to landscapers, nurseries and garden centers.

Pine straw might also provide economic opportunity for marginal and poor quality forest acreage. Sites that are unsuitable for producing wood fiber may provide reasonable economic return from pine straw. Landowners may even manage stands to produce straw as the primary product and wood fiber as the secondary product.

Landowners have three choices when selling pine straw—harvest the straw and sell it at retail, lease the land for baling rights, or sell loose straw to a "bulk buying" service.

Leasing Land for Pine Straw

Per bale

Two types of leases are written for leasing land for pine straw harvesting. First is a "per bale" contract in which the landowner is paid per bale harvested (approximately $0.10 to $0.25 per bale). This method is often preferred by harvesters because it offers more operational flexibility with smaller risk to the harvester. The landowner, however, must carefully account for each bale of pine straw. Consequen-tly, landowners may not prefer this leasing method.

Per acre

Another type of leasing contract is a "per acre" basis. With this method, the harvester pays the land-owner a set amount per acre per year to harvest pine straw on the landowner's plantation. Typical "per acre" baling rights range from $12.50 to $30 per acre depending on site cleanup costs.

Regardless of the lease type, landowners should be compensated on a sliding scale with higher pay over time as sites become cleaner and easier to harvest. Thus, landowners should obtain competitive bids periodically (every 3 to 5 years). Pine straw harvesting in East Texas can be highly profitable for all parties involved if good management practices are followed.

Retail sales of Texas pine straw could increase if markets were expanded to the major urban markets.

Annual Yields

Typically, East Texas pine plantations yield 100 to 150 bales per acre per year—approximately 2 tons per acre each year—if all conditions are right. The quantity varies from as little as 60 bales per acre on less suitable sites to as many as 200 bales per acre on exceptional sites. Straw yields depend on factors such as:

- Tree age
- Species
- Stand density
- Soil fertility
- Season
- Interval between harvests
- Bale size
- "Cleanliness" of stand
- Raking efficiency

Tree Age

In general, vigorously growing younger stands produce more needles than overly mature, stagnant stands. This also holds true for wood production. Also, a well-managed, clean stand with several years' accumulation of needles will not necessarily provide greater yield than a well-managed, clean stand with only 2 years of needle fall because older needles disintegrate, become too brittle to bale and turn grayish. Customers prefer the fresh, reddish-brown needles.

Stands as young as 7 years of age have been successfully harvested for pine straw. Although landowners may begin raking younger stands, the yields will be too low to warrant the use of mechanized equipment. Pine straw yield increases with stand age up to approximately 15 years of age, when the yield peaks. After 15 years of age there is a slight decline in needle fall, though yields remain fairly constant for the remainder of a typical rotation (25 to 35 years).

Stand Density

Pine straw production increases as the total basal area per acre increases. Studies have found that stands with a density of about 75 square feet per acre will produce approximately 125 30-pound bales per acre. More dense stands of 125 square feet per acre may yield 175 30-pound bales per acre provided that all fallen needles can be harvested. However, the health and productivity of the tree crop for producing wood fiber must be considered. Although great quantities of straw might be produced from denser stands, overly dense stands slow individual tree growth and may increase losses to disease, insects, natural mortality and fire. A professional forester can help determine the best stand density for a specific site.

Season

Needles stay on the branches for about 2 years, after which they turn reddish brown and fall. While needles fall throughout the year, under normal weather conditions the heaviest shedding occurs in September and October. In fact, 80 percent of needle fall occurs from mid-August to December. December, January and February are prime months for raking if bales can be carried directly to the dealer or stored under shelter. However, wet weather during these months often prevents baling because the pine straw must be dry for raking, baling and for the use of equipment in the forest. Harvesters who hand rake may still collect pine straw during the wet

season if they have an indoor drying facility to dry the straw before it is baled. Otherwise, August through November are the ideal months for harvesting pine straw in East Texas.

Pine Straw Harvesting

Cost of Harvesting

In Texas, costs for harvesting and marketing loblolly pine straw tend to be higher than in other Southern states where the pine straw market is more established (e.g., Georgia, Florida, Louisiana and Arkansas). This increased initial cost is largely due to the cost associated with preparing or "cleaning" an existing stand for the first-time mechanical harvesting of pine straw. The cost of initial cleaning is estimated to be approximately $200 per acre. However, initial cleanup costs can vary from less than $100 per acre (if hand raking) to more than $300 per acre.

Harvesting equipment and infrastructure costs depend upon whether the producer is baling on a large commercial scale or on a small scale. Generally, small operations may need only $200 worth of equipment to bale an average size plantation (35 to 50 acres), not including labor, because straw may be raked by hand and baled with a hand-powered baling box (Fig. 4). See Appendix for pine straw baler plans.

Most small operations can bale and deliver straw without storage. In addition, many forest landowners who also own farms may already have much of the necessary equipment for pine straw harvesting (e.g., dump rake, mechanical hay baler, small tractor, trailer, barn).

In Texas, the total costs for loblolly pine straw harvesting and commercial marketing are an estmated $2.00 to $2.50 per bale once the stand is "clean." The first year, due to cleanup and marketing costs, harvesters have an estimated $4 to $6 tied up in each 40- to 50-pound bale. In addition, a commercial scale operation may initially require more than $50,000 in specialized equipment (Fig. 5) and labor to be competitive. Because of the large volume of production, a commercial operation must also have seasonal storage and large trucks/trailers to haul bales to market.

Figure 4. Pine straw can be baled with a simple hand-powered box bailer.

Figure 5. A Star Mini-Roll round baler used for commercial scale operations.

Good Pine Straw Stand Requirements

Not every plantation is suitable for pine straw baling. A site should be free of erosion. Harvesters prefer to start harvesting in stands that are at least 10 years old but have not yet been thinned. Sites should carry from 90 to 110 square feet of basal area to maximize both needle and wood production. At the very minimum, 70 to 75 square feet of basal area is required to provide enough shade to eliminate grasses on the forest floor.

If baling mechanically, sites must be clean and flat. Planted pastures or oil fields with few or no terraces provide the ideal pine straw harvesting stand. Many stands have too much herbaceous

material, and cows are a potential problem if your market does not want extra nutrients added.

If the site is to be mechanically baled, the optimum row spacing depends on the size and shape of the equipment used for raking and baling. Although old style equipment requires 12 to 16 feet between rows for equipment access, newer, specialized equipment requires only 6 to 8 feet between rows to move the equipment. However, to be practical, 8 to 12 feet between rows is needed even for specialized equipment. New plantations can be planted with wide row spacing for easier use of equipment during harvesting as well as for timber production.

Harvesting Process

Surprisingly, raking and baling are the easiest and fastest parts of harvesting. Cleanup and gathering and transporting the bales are more difficult because labor is intensive and expensive. For example, a highly productive crew of five people will require 2 to 3 weeks to prepare, clean, rake, bale and haul pine straw bales from a typical 30-acre plantation.

To harvest pine straw by machine in a typical pine plantation requires the following steps:

- Remove (prune) the lower limbs of every tree that might block the movement of equipment and laborers within the rows. Prune by hand with machete or special saws for approximately $0.85 per tree, or remove limbs more cost effectively by using a modified cutter attached to a small tractor (Fig. 6). Depending on tree height, pruning may not be necessary in hand-raking operations.
- Remove all trees and shrubs within the baling rows. Special contractual arrangements might be made with a harvester to remove diseased trees within the rows as well.

Figure 6. A blade attached vertically to a tractor can be used to prune trees quickly.

- Remove all limbs and other debris from the baling rows. The debris must be picked up or raked off the p site. Depositing the debris every seventh row eliminates the need to move the debris great distances and reduces labor cost (Figire 7).

Figure 7. A pepared stand in which every sixth row is used as a debris row.

- Rake the pine needles by hand or by machine into windrows. Exclude any insects (ants), excess litter, grass and hardwood leaves that might reduce the value of the bale. Low-grade straw that contains extraneous debris or partially decomposed needles may be sold at a discount. Be careful to avoid seeds of noxious weeds, bahia grass and other plants that might present a problem in landscaping yards or flower beds.
- Bale by hand or by machine. Twine should be tight enough to hold bales securely without breaking.
- Transport bales out of the woods.

Figure 8. Pine straw baled by machine to produce rectangular bales.

- Deliver to markets or to a storage barn and protect bales from rain to prevent molding and nutrient leaching (Fig. 9).

Figure 9. A barn is needed to protect and/or dry pine straw.

Environmental Considerations

Fertility

Some forest managers are concerned that removing pine straw may be detrimental to the crop trees. Studies indicate that as few as two harvests within 3 years can reduce wood production of some stands by 50 cubic feet per acre compared to sites where no pine straw is harvested.

Straw contains important nutrients—nitrogen, phosphorus, calcium and magnesium—that return to the soil as the straw breaks down. Raking straw removes many of these nutrients from the forest stand, and tree growth and vigor may decline, especially on marginal sites where fertility is low. As much as 40 pounds of nitrogen is lost for every 100 bales of straw per acre harvested. Poor nutrition will increase rotation length of the crop trees, decrease vigor and make trees more susceptible to insect and disease. Fertilization may be required to replenish the nutrients lost from harvesting pine straw, maintain or improve the growth of the crop trees, and boost pine straw production. Unfortunately, fertilization will also increase the growth of unwanted vegetation, which must be controlled by mowing or applying herbicides.

Since forest stands respond differently to fertilization, determine the required rates of nitrogen, phosphorus and potassium by performing a correct and thorough soil and foliar analysis and then manage accordingly. A county Extension agent or Texas Forest Service forester can help.

Phosphorus increases wood growth and nitrogen stimulates foliage growth and pine straw yields. Typical fertilization recommendations for timber production are to broadcast 150 to 200 pounds of nitrogen per acre and 50 pounds of elemental phosphorus per acre every 5 years. Broadcasting 250 pounds of DAP per acre will apply the needed 45 pounds of nitrogen and 50 pounds of phosphorus. The additional 100 to 150 pounds of nitrogen per acre can be applied as urea fertilizer. Potassium might also be supplemented at a rate of 50 to 80 pounds per acre. Apply fertilizer in late January or early February. A typical application will cost between $25 and $55 per acre.

Soil and Water

As in a landscape bed, pine straw on the forest floor performs other functions.

- It holds moisture of partially decayed straw, which is important for tree survival and growth during summer months and water stress periods. In fact, reduced plant growth is often attributed to water stress.
- It helps insulate the soil from temperature extremes that can reduce tree growth.
- It prevents erosion of topsoil.

Consequently, it is important for harvesting operations to leave a thin layer of straw and organic matter (Fig. 10).

Figure 10. A layer of pine straw on the forest floor is an essential part of the forest ecosystem.

Other Concerns

Raking straw can affect the diversity and richness of plant and animal species. Harvesting pine straw from a site can dramatically alter the natural ecological system because pine needles provide food and habitat for animals that help decompose litter, improve soil tilth, and serve as food for wildlife. Furthermore, harvesting pine straw may have long-

Figure 11. Sensitive areas such as this stream side should be protected from regular pine straw removal.

term effects on soil chemistry (e.g., from acidic to neutral or basic) that are not yet fully understood. For these reasons, it is desirable to identify unique and/or sensitive areas and shield them from straw production altogether or rake no more than every 4 years to reduce any long-term harm.

Tending Stands for Pine Straw

Most stands of pine that are being considered for straw harvesting are not yet desirable for straw production. A great deal of effort and planning is required to prepare East Texas stands for harvest of pine straw that is free of cones, leaves, limbs and trash. In fact, at least 2 years of preparation may be required before high quality, clean straw can be mechanically harvested with minimal effort. Preparation steps include:

- *Develop a management plan* — Managing a successful forest resource enterprise, like any other business, involves planning and decision making. A successful management plan includes:
  - Realistic, clear and concise objectives that define your level of involvement.
  - Investigation of the marketing potential of pine straw in your area.
  - Knowledge of the biological and manage ment potential and/or concerns of harvesting pine straw on your land.
  - Identification of any major limiting factors such as financial or taxation constraints that may limit your success.
  - Enlisting the help of professionals.
- *Competition control* — Understory vegetation interferes with raking and reduces the quality of a bale. Control unwanted shrubs, weeds and trees with herbicides or mowing.
- *Prune* — Remove lower limbs of pines to facilitate harvesting. The lower limbs can interfere with harvesting equipment and/or people. Live limbs not receiving partial light may also cause stress on the crop tree, so pruning may improve wood quality.
- *Clean* — Clear the area of all twigs, pine cones and tree limbs. This can be done manually on a site that has an especially desirable quantity of straw. Otherwise, mechanically rake all debris, including some straw, and do not harvest straw that year.
- *Fertilize* — Tree growth may be improved with fertilization on some sites. Fertilization may also raise straw production by increasing the amount of foliage on each tree. Studies have found that fertilization may increase needle biomass as much as two to five times. Increased herbaceous vegetation will need to be eliminated before raking.

Figure 12. Poultry litter being broadcast in a 17-year-old pine plantation.

Stand Establishment

To establish a new pine straw site, select a location that has been previously used for crops or pasture and is relatively level. If timber production is the main objective, the site should be large enough to have at least 20 acres in well-managed stands. Perform the site preparation steps (sub-soiling, tilling) needed to ensure survival and productivity of newly planted seedlings. Purchase good quality pine seedlings from a nursery that has a good reputation for seedling quality and care. Don't wait until planting season to order seedlings; place seedling orders in April or May. Carefully plant trees in well-marked rows 8 to 12 feet apart. While

trees are growing, control underbrush and other undesirable trees that may hinder survival and growth and cause problems later with the raking of the pine straw. To ensure the best chance of survival and productivity, follow guidelines in Extension publication B-6115, "Loblolly Pine Planting."

The Potential of Pine Straw Production

Pine straw production has the potential to supplement the income of landowners during years when they will receive no income from a timber harvest. Producing pine straw is a natural process and requires very little management to ensure an adequate supply for the market. However, if a landowner decides to purchase the equipment needed to bale pine straw and transport it to market, expenses may exceed income for many years of pine straw production. The method that provides the most profit immediately to the landowner is contracting with a baling service company that will pay per acre for baling the forest stand. The landowner should be aware that supplemental fertilization will likely be needed if pine straw is baled regularly.

Maintaining a basal area of about 90 square feet per acre helps control understory vegetation and maximize straw yields. Although pine straw may be harvested every year, it is preferable to do it every 2 years on more sensitive sites to prevent soil compaction, soil erosion and lower wood and straw productivity caused by annual raking.

Appendix — Pine Straw Hand Baler Plans

Part	Description	Stock (inches)	Length (inches)
A	Handle	2 x 3	50
B	Lever bolt 1-2 bolt 2-3	 2 x 3 2 x 3	 9.5 7.0
C	Compressor arm	2 x 4	24
D	Compressor pad	1/2 plywood	10.5 x 12.5
E	Pad supports	2 x 4	10.5
F	Lever fulcrum	2 x 4	20
G	String holder see Fig. A-2	 nails	 2.5
H	Front brace	2 x 2	18
I	Plywood sides Plywood back	1/2 plywood 1/2 plywood	43 x 12 43 x 15.5
J	Corner supports	2 x 4	43
K	Door	1/2 plywood	15.5 x 38
L	String retainers see Fig. A-3	 I-bolts	 1
M	Deck	1/2 plywood	59 x 15.5
N	String	nylon	

Figure A-1. A typical, easy-to-construct, hand-powered box baler showing the main components.

Figure A-2. A rear view of the top of a box baler showing the nail used to hold the baling string in place as pine straw is loaded into the baler.

Figure A-3. A view of the four eye-bolts at the bottom of the baler that hold the string in the proper alignment as the pine straw is loaded and compressed.

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This publication was funded through a grant by the USDA Forest Service in cooperation with Pineywoods RC&D Council Inc. Please visit Texas Cooperative Extension Forestry's Web site at http://extensionforestry.tamu.edu.

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